Cambridge International **A Level**

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2014**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

1 **(a)** The enzyme ethanol dehydrogenase occurs in a wide variety of organisms. It is able to catalyse a reversible reaction that converts ethanol to ethanal or ethanal to ethanol.

Ethanol is toxic and in some tissues the ethanol can be converted to ethanal and then to ethanoate (acetate) which is used as an energy source.

Fig. 1.1 shows these reactions.

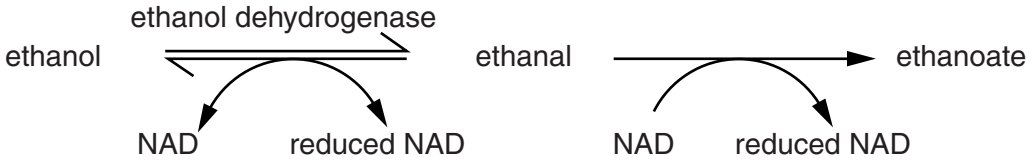

Fig. 1.1

In industry ethanol is converted to ethanal, which is used to make a variety of compounds, such as dyes, flavourings and perfumes.

A student carried out an investigation to find out if the activity of immobilised ethanol dehydrogenase differed from that of non-immobilised (free) ethanol dehydrogenase.

The student:

- immobilised a 1 mg dm^{-3} ethanol dehydrogenase solution
- used both the NAD and the ethanol at concentrations of 10^{-3} mol dm^{-3}
- used methylene blue as an indicator of enzyme activity. Methylene blue becomes colourless when oxidised
- measured the time for methylene blue to become colourless.

(i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....[2]

(ii) Outline how the student could immobilise the enzyme ethanol dehydrogenase.

.....

.....

.....

.....

.....

.....[3]

(iii) Suggest a suitable control for this investigation.

.....

.....[1]

(b) Describe a method the student could use to find the activity of the immobilised and free ethanol dehydrogenase.

Assume that the immobilisation traps all of the available enzyme from the solution.

Your method should be detailed enough for another person to use.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[7]

(c) The results of the student's investigation are shown in Table 1.1.

Table 1.1

rate of reaction / arbitrary units ±*s*			
experimental		control	
free enzyme	immobilised enzyme	free enzyme	immobilised enzyme
0.0333 ± 0.0024	0.0222 ± 0.0022	0.00012 ± 0.0001	0.00010 ± 0.0002

(i) Describe how the student could calculate the rate of reaction, taking into account the results of the control experiments.

.....

.....

.....

.....

.....

.....[2]

(ii) State what standard deviation (*s*) shows about the results of this investigation.

.....

.....

.....

.....

.....

.....

.....[2]

(d) The student carried out a statistical test to find out if the difference in the rate of reaction between the immobilised and free enzyme was significant.

The results were significant at $P < 0.05$. Explain what this means.

.....

.....

.....

.....

.....

.....[2]

[Total: 19]

2 An investigation into feeding relationships in a community was carried out using radioactively labelled phosphorus (^{32}P). A solution containing ^{32}P labelled phosphate ions can be supplied to a plant using a stem well.

Fig. 2.1 shows a vertical section through a stem well.

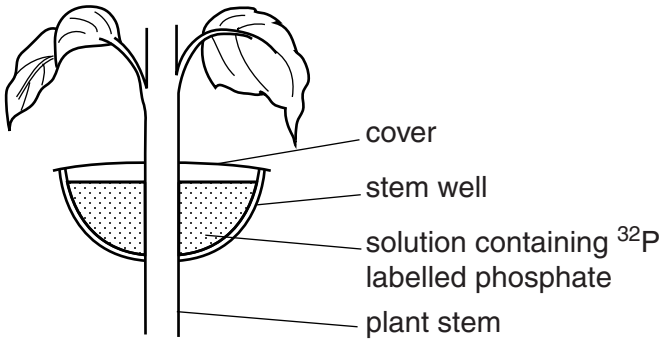

Fig. 2.1

- Stem wells were used to supply 200 individual plants of the dominant herbaceous species in the community with a solution containing ^{32}P phosphate ions.
- The stem wells were left in place for one week and then removed.
- At intervals during the first week and for a further 11 weeks after the wells were removed, tissue samples were taken from the plants and from other members of the community.
- The activity of ^{32}P phosphate ions per unit biomass was measured in each sample.

Fig. 2.2 shows the results of this investigation.

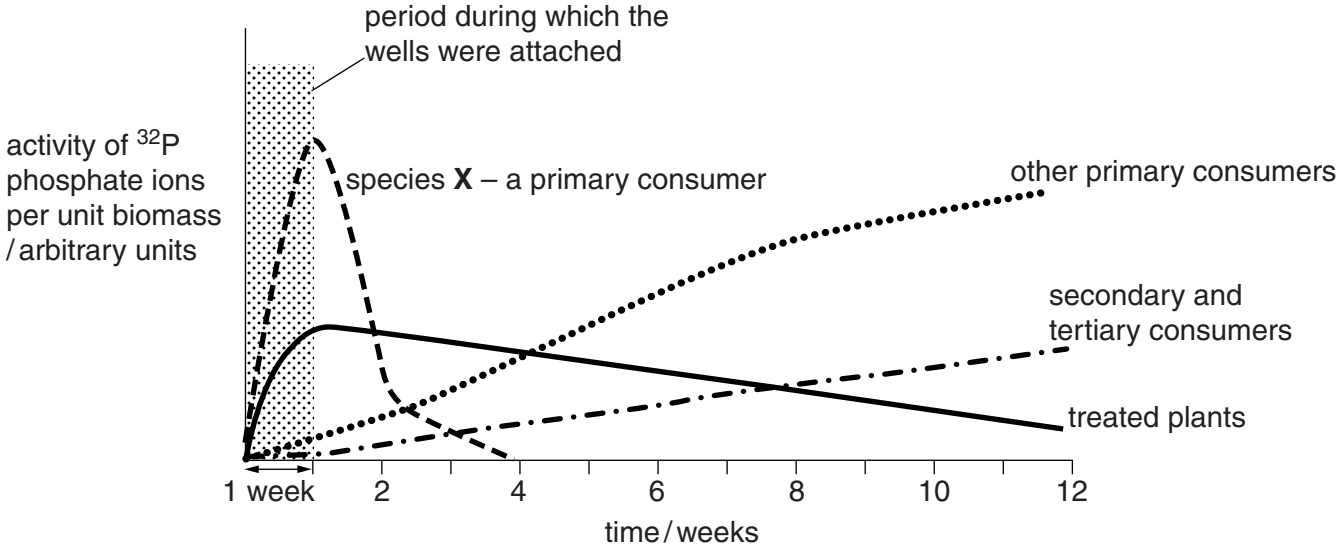

Fig. 2.2

(a) (i) Identify **one** variable that has been standardised in this investigation.

.....

.....[1]

(ii) Suggest **one** other variable that should be standardised.

.....

.....[1]

(b) (i) The mass of the samples taken from different members of the community varied. The radioactivity of each sample was measured using a Geiger counter.

Suggest how the activity of ^{32}P phosphate ions **per unit biomass** was calculated.

.....

.....[1]

(ii) State why the activity of ^{32}P phosphate ions per unit biomass was calculated.

.....

.....[1]

(c) (i) A student made the following conclusions from information in Fig. 2.1 and Fig. 2.2.

1. Radioactive ^{32}P passes into secondary and tertiary consumers from primary consumers.
2. Radioactivity in species **X** increases as ^{32}P labelled phosphate is used to synthesise DNA and ATP.
3. Other primary consumers do not obtain food from the treated plants.
4. Radioactivity in the treated plants increases because the ^{32}P labelled phosphate is absorbed into the stem and transported in the phloem.

State, with a reason, whether the evidence in Fig. 2.1 and Fig. 2.2 supports or does not support **each** of these conclusions.

1. .....

.....

.....

2. .....

.....

.....

3. .....

.....

.....

4. .....

.....

.....[4]

(ii) Suggest **one** other conclusion, supported by the evidence in Fig. 2.2, that the student could draw from this investigation.

.....

.....

.....[1]

(d) The aim of this investigation was to study feeding relationships in a community.

Suggest how this investigation could be improved to find all the feeding relationships in the community.

.....

.....

.....

.....

.....

.....

.....[2]

[Total: 11]